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COMPOSITE MATERIAL OF THE Ti-Ta-Zr SYSTEM INTENDED TO WORK IN BOILING SULFURIC AND HYDROCHLORIC ACIDS*

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This study is a continuation of a series of works on the study of composite materials obtained by surfacing corrosion-resistant layers on a titanium base using an electron beam of the MeV range of electron energy released into the atmosphere. This method allows the surfacing of powder mixtures containing corrosion-resistant elements with very different melting points, in particular, from the series Ti, Ta, Nb, Zr, etc. Volumetric heating of the powder mixture of these elements makes it possible to avoid segregation during coating formation. The coating thickness is about 2 mm. As shown in previous publications [1,2], coatings of the Ti-Ta and Ti-Ta-Nb systems exhibit high resistance in especially aggressive corrosive environments, in particular, in concentrated (65%) boiling nitric acid. However, these coatings are not sufficiently stable in two other strong acids at boiling points: sulfuric and hydrochloric. Due to zirconium is more stable in mentioned acids than niobium, the including of it instead of niobium in the surfaced powder mixture allow to increase the corrosion resistance of surfaced layer [3, 4], but the resistance of it still quite not sufficient for industrial applications. Only a sharp increase in the alloying concentration in the Ti-Ta-Zr system made it possible to obtain an anti-corrosion layer that is quite efficient also in boiling sulfuric and hydrochloric acids. A high alloying concentration was achieved, in particular, due to the repeated surfacing of the initial powder mixture on the layer formed after the first surfacing. The composition of the deposited layer after the first surfacing was 31%Ta-12%Zr, Ti-rest, after the second - 48%Ta-20%Zr, Ti-rest.

The authors used a method of weight control for corrosion resistance characterization. A number of coatings with gradually increasing alloying levels were tested. The results for the layer with the highest concentration compared to the titanium substrate materials, pure zirconium and pure tantalum, taken in the form of plates are shown in the table blow.

Table. Corrosion resistance in the boiling acids of the most alloyed layer, titanium base material, commercially pure zirconium and tantalum, mm/year.

Sample composition	65% HNO_3	40% H_2SO_4	20% HCl
BT1-0	0.191	1980	389
48%Ta-20%Zr-32%Ti	0.006	0.071	0.191
Zr	0.001	0.016	0.41
Ta	0.000	0.001	0.000

Conclusion. The use of a mixture of zirconium and tantalum in the formation of an anti-corrosion coating makes it possible to obtain a protective coating with maximum alloying. The corrosion resistance of the resulting coating is enough to use it for operation in boiling sulfuric and hydrochloric acids with sufficiently high concentrations.

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